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Notes:

1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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FULL CONTENTS

[Claim(s)]

[Claim 1]Have the following, and said processing means asks for said true **** from said **** detection value by performing error amendment processing based on said 1st standard **** detection value and said 2nd standard **** detection value, and said angle-of-traverse detection value is received, An ultrasonic detection device searching for said true angle of traverse by performing error amendment processing based on said 1st standard angle-of-traverse detection value and said 2nd standard angle-of-traverse detection value.

A transducer which is attached to a base and rotates in the **** direction and the direction of an angle of traverse to this base.

A **** detection means to detect **** of said transducer and to output a **** detection value. An angle-of-traverse detection means to detect an angle of traverse of said transducer and to output an angle-of-traverse detection value.

While asking for true **** of said transducer based on said **** detection value, A processing means to search for a true angle of traverse of said transducer based on said angle-of-traverse detection value, and to ask for the detection direction of a target by said transducer based on **** and a true angle of traverse of further these truth, While remembering beforehand said **** detection value in case true **** of said transducer is the 1st standard **** to be a displaying means which displays picture information of said target on a position on a screen corresponding to said detection direction as 1st standard **** detection value, A **** memory measure which memorizes beforehand said **** detection value in case said true **** is the 2nd standard **** as 2nd standard **** detection value, An angle-of-traverse memory measure which memorizes beforehand said angle-of-traverse detection value in case said true angle of traverse is the 2nd standard angle of traverse as 2nd standard angle-of-traverse detection value while memorizing beforehand said angle-of-traverse detection value in case a true angle of traverse of said transducer is the 1st standard angle of traverse as 1st standard angle-of-

traverse detection value.

[Claim 2] In the device according to claim 1, [said true ****] Set **** of this truth to thetaa, set said **** detection value to Va, and said 1st standard **** detection value is set to Va0, Set said 2nd standard **** detection value to Va1, and said 1st standard **** is set to theta 1, When setting said 2nd standard **** to theta 2, ask based on the following formula and thetaa= {(Va-Va0)/(Va1-Va0)} x(theta2-theta1)-theta1, and, [said true angle of traverse] Set an angle of traverse of this truth to thetab, set said angle-of-traverse detection value to Vb, and said 1st standard angle-of-traverse detection value is set to Vb0, An ultrasonic detection device characterized by asking based on the following formula and thetab={(Vb-Vb0)/(Vb1-Vb0)} x (theta4-theta3)-theta3 when setting said 2nd standard angle-of-traverse detection value to Vb1, setting said 1st standard angle of traverse to theta 3 and setting said 2nd standard angle of traverse to theta 4.

[Detailed Description of the Invention]

[0001]

[Field of the Invention][this invention] [about the ultrasonic detection device which detects a target by transmitting and receiving an ultrasonic wave to the predetermined detection direction] It is related with the ultrasonic detection device which can detect said target broadly by rotating mechanically the transducer for transmitting and receiving an ultrasonic wave especially in the direction of an angle of traverse, and the **** direction.

[0002]

[Description of the Prior Art] The detection device using an ultrasonic wave is used as a device for detecting from the former the target which is underwater. Generally, this detection device has a transducer for transmitting and receiving an ultrasonic wave, and the picture information of the target obtained by this transducer is displayed on a display for indication.

[0003] Recently, in this kind of detection device, in order to detect broadly, the composition which detects while rotating a transducer in the direction of an angle of traverse and the **** direction mechanically is adopted.

[0004] In this case, the potentiometer for detecting the mechanical angle of traverse and **** of a transducer is formed in a detection device, and it is asked for the detection direction by this transducer based on the angle of traverse and **** of a transducer which were detected with this potentiometer. And the picture information of the obtained target is displayed on a display for indication by the position on the screen corresponding to said detection direction.

[0005]

[Problem to be solved by the invention] By the way, in order to obtain the detection direction, he uses a potentiometer and is trying to detect the mechanical angle of traverse and **** of a transducer in an above-mentioned detection device. For this reason, when attaching a transducer to the ship's bottom of a vessel, for example and the attachment error has arisen, an error will be included also in the detection direction obtained based on the angle of traverse and **** of a transducer which were detected with the potentiometer. In this case, the problem that the detection direction (position) currently displayed on the display for indication and the actual detection direction are not in agreement arises.

[0006] In order to solve such a problem, the potentiometer needed to be adjusted according to the attachment error of a transducer, but since this potentiometer was attached near the ship's bottom of a vessel, the inconvenience it becomes complicated the adjustment working had produced it.

[0007] This invention is made in consideration of such SUBJECT, and is a thing.

The purpose is to provide the ultrasonic detection device which can get to know the detection direction to depend easily and correctly.

[0008]

[Means for solving problem] He is trying to ask for the detection direction of the target by this transducer in the ultrasonic detection device concerning this invention based on true **** of a transducer, and a true angle of traverse. Said true **** is called for from the **** detection value corresponding to **** of said transducer obtained by the **** detection means by performing error amendment processing based on the 1st standard **** detection value and the 2nd standard **** detection value. True **** of said transducer is the **** detection value detected, respectively when it was the 1st standard **** and the 2nd standard ****, and the standard **** detection value of these 1st and the 2nd standard **** detection value are beforehand memorized by the **** memory measure. On the other hand, said true angle of traverse is searched for from the angle-of-traverse detection value corresponding to the angle of traverse of said transducer obtained by the angle-of-traverse detection means by performing error amendment processing based on the 1st standard angle-of-traverse detection value and the 2nd standard angle-of-traverse detection value. The true angle of traverse of said transducer is the angle-of-traverse detection value detected, respectively when it was the 1st standard angle of traverse and the 2nd standard angle of traverse, and the standard angle-of-traverse detection value of these 1st and the 2nd standard angle-of-traverse detection value are beforehand memorized by the angle-of-traverse memory measure. And the picture information of said target is displayed on the position on the screen corresponding to the detection direction of the target by a transducer for which the displaying means was asked based on **** and said true angle of traverse of said truth (invention given in Claim 1).

[0009] Said true **** sets **** of this truth to thetaa, and specifically sets said **** detection value to Va, Set said 1st standard **** detection value to Va0, and said 2nd standard **** detection value is set to Va1, When said 1st standard **** is set to theta 1 and said 2nd standard **** is set to theta 2, Ask based on the following formula and $\text{thetaa} = \{(Va - Va0) / (Va1 - Va0)\} x(\text{theta2} - \text{theta1}) - \text{theta1}$, and, [said true angle of traverse] Set the angle of traverse of this truth to thetab, set said angle-of-traverse detection value to Vb, and said 1st standard angle-of-traverse detection value is set to Vb0, When setting said 2nd standard angle-of-traverse detection value to Vb1, setting said 1st standard angle of traverse to theta 3 and setting said 2nd standard angle of traverse to theta 4, it asks based on the following formula and $\text{thetab} = \{(Vb - Vb0) / (Vb1 - Vb0)\} x(\text{theta4} - \text{theta3}) - \text{theta3}$ (invention given in Claim 2).

[0010] By constituting in this way, it can ask for the true angle of traverse of a transducer, and true ****, i.e., the detection direction of the target by said transducer, easily and correctly.

[0011]

[Mode for carrying out the invention] Hereafter, the 1 embodiment of this invention is described with reference to Drawings.

[0012] Drawing 1 shows the composition of the ultrasonic detection device 10 with which the 1 embodiment of this invention was applied.

[0013] The ultrasonic detection device 10 is provided with the following.

The transmission-and-reception wave device 14 provided with the transducer 12 which transmits and receives an ultrasonic wave to the predetermined detection direction.

The display device 18 which performs image display processing to the display for indication 16 based on the picture information of the target obtained with said transmission-and-reception wave device 14.

[0014] The transducer 12 is constituted by the vibrator etc. and transmits the ultrasonic wave according to the transmitted signal St supplied. the transducer 12 will output received signal Sr, if the reflective echo which is the ultrasonic wave which was reflected in the target and had been carried out since ** is received.

[0015] Drawing 2 is a side view of the transducer 12 attached to the vessel S which is a base, and drawing 3 is a bottom view of this transducer 12 in the state which shows in drawing 2 as a solid line.

[0016] As shown in drawing 2, the transducer 12 is connected at the tip of the shaft 20, and is attached to the ship's bottom of the vessel S via this shaft 20. In this case, the transducer 12 is turned underwater and it may be made to make it move from a ship's bottom by displacing the shaft 20 in the up-and-down direction.

[0017] The transducer 12 is formed in the shape which cut and lacked the part along the direction of an axis from the shape of a cylindrical shape as shown in drawing 1 and drawing 3.

Specifically, the section shape in the field which intersects perpendicularly with the axis of the transducer 12 is the shape which cut and lacked a part of ring shape in the range of 120 degrees from the center. In this case, in the transducer 12, to an axis, it cuts, use the opposite side of the lacked portion as the front, and let said portion side cut and lacked be the back. [0018]As shown in drawing 1, the transmission-and-reception wave device 14 is provided with the following.

The **** drive 22 made to rotate the transducer 12 in the **** direction.

The angle-of-traverse drive 24 made to rotate said transducer 12 in the direction of an angle of traverse.

In this case, the transducer 12 rotates in -170 degree<=thetab<=+170 degree in the direction of an angle of traverse in the level surface, as are shown in drawing 2, and it rotates in 0 degree<=thetaa<=90 degree in the **** direction and is shown in drawing 3 within a vertical plane. thetaa expresses true **** (it is hereafter described as true ****.) of the transducer 12, and thetab expresses the true angle of traverse (it is hereafter described as a true angle of traverse.).

[0019]In this case, it intersects perpendicularly with the axis of the transducer 12 in the level surface, and true angle-of-traverse thetab when the direction of movement (the inside of drawing 2 and drawing 3, the direction of arrow A) of the vessel S is the same as the direction (the inside of drawing 3, the direction of arrow B) which goes to the front from the back of this transducer 12 is made into thetab=0 degree. Said direction of arrow B expresses the inclination direction of the ultrasonic beam in the transducer 12. And make into the direction of right (+) of true angle-of-traverse thetab the direction which the transducer 12 rotates rightward among drawing 3, and let the direction which said transducer 12 rotates leftward be the direction of negative (-) of true angle-of-traverse thetab.

[0020]True **** thetaa in case a plumb line and said direction of arrow B aim to cross at right angles is made into thetaba=0 degree among drawing 2, and true **** thetab in case said direction of arrow B is the direction of perpendicular facing down is made into thetaba=90 degree.

[0021]in addition -- the range of these true **** thetab and true angle-of-traverse thetab takes into consideration in fact the error amendment processing mentioned later -- every [more nearly predetermined than the above-mentioned value / an angle] -- it is taken widely.

[0022]As shown in drawing 1, the angle-of-traverse drive 24 is constituted by a motor, reduction gears, a gear (not above shown), etc. which rotate the shaft 20 to which the transducer 12 was attached. In this case, the mechanism for regulating the rotating range of the shaft 20 is constituted by the cam (not shown) provided in said shaft 20, and the limit switch (not shown) which contacts said cam in the termination position of the rotating range of said shaft 20. The angle-of-traverse drive 24 may be constituted so that rotating operation to

the direction of an angle of traverse of the transducer 12 may be performed manually.

[0023]On the other hand, the **** drive 22 is constituted by the rod which moves along with the shaft 20, the cam mechanism which rotates the transducer 12 in the **** direction with the attitude of this rod, the motor which makes said rod move, reduction gears, the gear, the ball screw (not above shown), etc. In this case, the mechanism for regulating the attitude range of a rod is constituted by the cam (not shown) provided in said rod, and the limit switch (not shown) which contacts said cam in the upper limit position and lower limit position of said rod. The **** drive 22 may be constituted so that rotating operation to the **** direction of the transducer 12 may be performed manually.

[0024]The transmission-and-reception wave device 14 is provided with the following.

The potentiometer (**** detection means) 26 for detecting **** (hereafter, in order to distinguish from true **** thetaa, it is described as detection ****,) thetaa' of the transducer 12.

The potentiometer (angle-of-traverse detection means) 28 for detecting angle-of-traverse (hereafter, in order to distinguish from true angle-of-traverse thetab, it is described as detection angle of traverse.) thetab' of said transducer 12.

In fact, the potentiometer 26 and the potentiometer 28 are constituted so that the degree of rotation angle of the shaft 20 and the attitude distance of a rod which is not illustrated may be detected, respectively. Detection angle-of-traverse thetab' detected with detection ****thetaa' and the potentiometer 28 which were detected with the potentiometer 26 is supplied to the display device 18 as the voltage value (**** detection value) Va and the voltage value (angle-of-traverse detection value) Vb, respectively.

[0025]The display for indication 16 of the display device 18 is constituted using display devices, such as CRT and LCD. Hereafter, the display for indication 16 may be described as CRT16.

[0026]The display device 18 has the control part 30 which controls the image display processing to said display for indication 16. This control part 30 CPU(processing means) 32 as a central processing unit, ROM34 which is a memory measure (memory) a system program, an application program, etc. are remembered to be, It is constituted by RAM which is a memory measure (memory) used as an object for work, etc., and the microcomputer in which input-and-output interfaces, such as a timer for a time check (time check means), an A/D conversion machine, and a D/A converter, etc. are included.

[0027]The **** storage area (**** memory measure) 38 and the angle-of-traverse storage area (angle-of-traverse memory measure) 40 are established in ROM34, [these **** storage area 38 and the angle-of-traverse storage area 40] The fiducial point (Va0, Va1 which are mentioned later) corresponding to true **** thetaa which is a fiducial point used when performing error amendment processing mentioned later, respectively, and the fiducial point (Vb0, Vb1 which are mentioned later) corresponding to true angle-of-traverse thetab are

memorized beforehand. It may be made to establish the **** storage area 38 and the angle-of-traverse storage area 40 in other memory measures, such as a hard disk.

[0028]The control part 30 supplies the **** indication signal Sa and the angle-of-traverse indication signal Sb to the **** drive 22 and the angle-of-traverse drive 24, respectively. Based on these **** indication signal Sa and the angle-of-traverse indication signal Sb, the **** drive 22 and the angle-of-traverse drive 24 drive, and the transducer 12 rotates in the **** direction and the direction of an angle of traverse.

[0029]The control part 30 supplies the transmitted signal St to the transducer 12. At this time, the ultrasonic wave according to this transmitted signal St is transmitted from the transducer 12. and if the ultrasonic wave which was reflected in the target and had been carried out since ** as a reflective echo is received by the transducer 12, from this transducer 12, received signal Sr will be outputted and the control part 30 will be supplied. The control part 30 analyzes the information on the target contained in this received signal Sr, and displays it on the display for indication 16 as picture information.

[0030]The voltage value Va from the potentiometer 26 is supplied to the control part 30 as **** data D (Va) via the A/D conversion machine 42. Similarly, the voltage value Vb from the potentiometer 28 is supplied to the control part 30 as angle-of-traverse data D (Vb) via the A/D conversion machine 44. CPU32 of the control part 30 obtains the transceiver direction (the detection direction) of the ultrasonic wave in the transducer 12 from the voltage value Va included in the **** data D (Va), and the voltage value Vb included in the angle-of-traverse data D (Vb).

[0031]The fiducial point (Va0, Va1) of the voltage value Va with which CPU32 is beforehand memorized in the **** storage area 38 of ROM34 in that case, [by amending the error included in the voltage value Va and the voltage value Vb (namely, detection ****thetaa' and detection angle-of-traverse thetab') based on the fiducial point (Vb0, Vb1) of the voltage value Vb memorized beforehand in the angle-of-traverse storage area 40] He is trying to ask for true **** thetaa and true angle-of-traverse thetab.

[0032][**** minimum fiducial point (1st standard **** detection value) Va0 which is one fiducial point of the voltage value Va] True **** thetaa of the transducer 12 is the voltage value Va acquired by the potentiometer 26, for example when it was thetaa=0 degree (1st standard ****), **** maximum fiducial point (2nd standard **** detection value) Va1 which is a fiducial point of another side of said voltage value Va is the voltage value Va acquired by the potentiometer 26, when said true **** thetaa is thetaa=90 degree (2nd standard ****), for example.

[0033][angle-of-traverse minimum fiducial point (1st standard angle-of-traverse detection value) Vb0 which is one fiducial point of the voltage value Vb] True angle-of-traverse thetab of the transducer 12 is the voltage value Vb acquired by the potentiometer 28, for example when

it was $\theta_{tab}=-170$ degree (1st standard angle of traverse), Angle-of-traverse maximum fiducial point (2nd standard angle-of-traverse detection value) $Vb1$ which is a fiducial point of another side of said voltage value Vb is the voltage value Vb acquired by the potentiometer 28, when said truth angle-of-traverse θ_{tab} is $\theta_{tab}=+170$ degree (2nd standard angle of traverse), for example.

[0034]When calculating **** minimum fiducial point $Va0$, **** maximum fiducial point $Va1$, angle-of-traverse minimum fiducial point $Vb0$, and angle-of-traverse maximum fiducial point $Vb1$, true **** θ_{taa} and true angle-of-traverse θ_{tab} are in the state which fixed the vessel S to dock, and are measured using an external measuring device, for example. As this measuring device, the transducer 12 is irradiated with a laser beam and the device which detects inclination of said transducer 12 etc. based on that reflected light is adopted, for example.

[0035]When asking for the detection direction by the transducer 12, true **** θ_{taa} is computed based on the following (1) type, and true angle-of-traverse θ_{tab} is computed based on the following (2) types.

[0036]

$\theta_{taa} = \{(Va - Va0)/(Va1 - Va0)\} \times (\theta_{ta2} - \theta_{ta1}) - \theta_{ta1} \quad (1)$

$\theta_{tab} = \{(Vb - Vb0)/(Vb1 - Vb0)\} \times (\theta_{ta4} - \theta_{ta3}) - \theta_{ta3} \quad (2)$

However, theta 1 is the 1st standard **** ($\theta_{ta1}=0$ degree), theta 2 is the 2nd standard **** ($\theta_{ta2}=90$ degree), theta 3 is the 1st standard angle of traverse ($\theta_{ta3}=-170$ degree), and theta 4 is the 2nd standard angle of traverse ($\theta_{ta4}=+170$ degree).

[0037]CPU32 asks for the detection direction by the transducer 12 based on direction of the vessel S detected by true **** θ_{taa} obtained from the aforementioned (1) formula and (2) types, true angle-of-traverse θ_{tab} , and the means which is not illustrated. And the control part 30 supplies the picture information of the target obtained with said transducer 12 to the display for indication 16 as information in said detection direction. By this, the picture information of a target is displayed on the display for indication 16 by the position on the screen corresponding to said detection direction.

[0038]Thus, the voltage value Va corresponding to detection **** θ_{taa}' obtained by the potentiometer 26 in this embodiment, He is trying to ask for true **** θ_{taa} and true angle-of-traverse θ_{tab} from the voltage value Vb corresponding to detection angle-of-traverse θ_{tab}' obtained by the potentiometer 28 by performing error amendment processing based on the aforementioned (1) formula and (2) types, respectively. For this reason, also when attaching the transducer 12 to the vessel S and the attachment error has arisen, this error can be canceled easily, therefore the detection direction of the target by the transducer 12 can be known correctly.

[0039]This invention of the ability of various composition to be taken is natural, without

deviating not only from an above-mentioned embodiment but from the gist of this invention.
[0040]

[Effect of the Invention][by performing error amendment processing to each of the angle-of-traverse detection value acquired by an angle-of-traverse detection means, and the **** detection value acquired by a **** detection means according to this invention] It is possible to ask for the true angle of traverse of a transducer and true ****, i.e., the detection direction of the target by said transducer, easily and correctly.

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the ultrasonic detection device with which the 1 embodiment of this invention was applied.

[Drawing 2]It is a side view of the transducer which constitutes the ultrasonic detection device shown in drawing 1.

[Drawing 3]It is a bottom view of the transducer which constitutes the ultrasonic detection device shown in drawing 1.

[Explanations of letters or numerals]

10 -- Ultrasonic detection device 12 -- Transducer

14 -- Transmission-and-reception wave device 16 -- Display for indication (CRT)

18 -- Display-device 26 -- Potentiometer (**** detection means)

28 -- Potentiometer (angle-of-traverse detection means)

30 -- Control part 32 -- CPU (processing means)

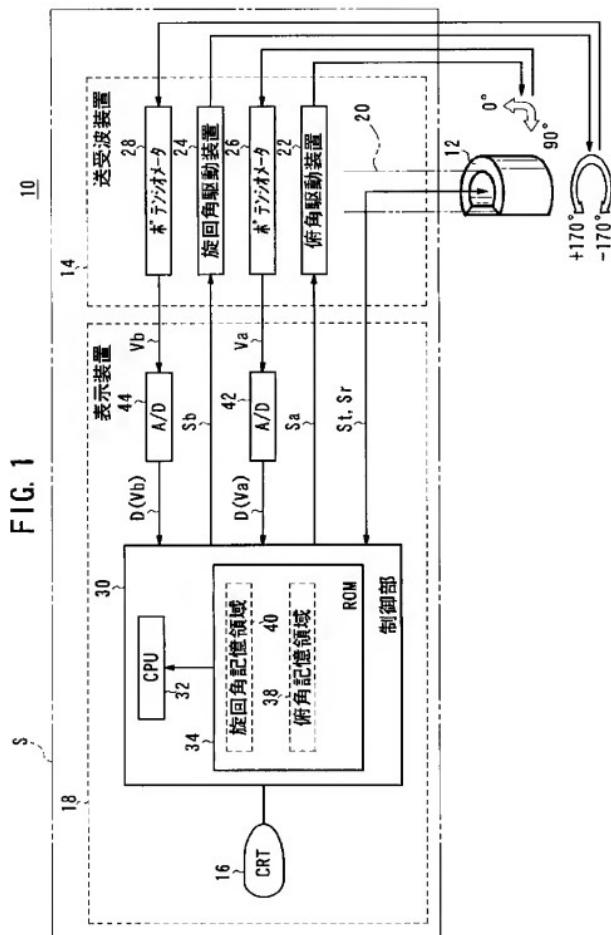
34 -- ROM 38 -- **** storage area (**** memory measure)

40 -- Angle-of-traverse storage area (angle-of-traverse memory measure)

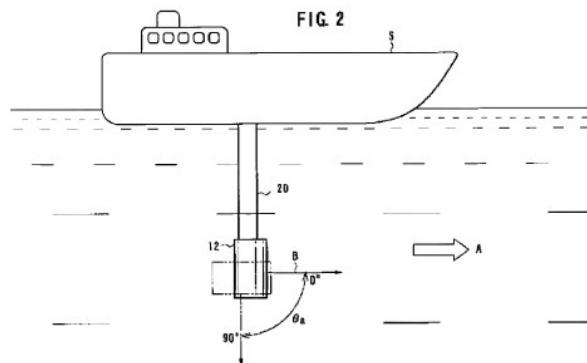
Va -- Voltage value (**** detection value) Vb -- Voltage value (angle-of-traverse detection value)

[Drawing 1]

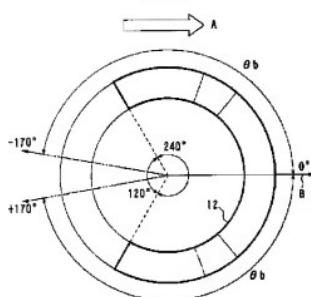
FIG. 1



[Drawing 2]



[Drawing 3]

FIG. 3

[Translation done.]